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A Quantitative Index to Rank and Select Electromagnetic Shields in Radiofrequency and Microwave Radiation

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Abstract

Background: In electromagnetic shielding topics, the selection of suitable shields is an important subject and the lack of a specific ranking index for choosing protective shields causes problems in decision-making. Thus, this study proposes a quantitative index to rank and select electromagnetic shields in radiofrequency and microwave radiation.
Objectives: The objective of this study was to construct a simple quantitative index to rank and select electromagnetic shields in radiofrequency and microwave radiation.
Methods: A cross-sectional study was designed. In this study, the construction of the ranking index was carried out in four main stages including stabilizing the concept, analytical structure and variable selection, weighing and combination of variables, and validating the index. In this study, the average, minimum, maximum, and standard deviation of shielding effectiveness were considered the main phenomenon variables. Finally, the ranking index and ranking difference index were created as percentages to rank and select electromagnetic shields.
Results: In this study, a quantitative index was made as percentages called "Ranking Index" to rank and select the premier and preferable shield. Moreover, to indicate the difference in the shielding effectiveness of various shields, the "Difference Index" was made as percentages.
Conclusions: This study presented a simple quantitative index to rank electromagnetic shields. It could be used as a selection tool in radiation safety management. Moreover, this ranking index had a simple formula that could be calculated easily and quickly in excel software with high accuracy and low cost. In addition, it could be easily incorporated into a user-friendly tool for the ease of application. A case study of electromagnetic nanocomposite shields was conducted to use the Ranking Index, which showed its capability for ranking the shielding performance of studied electromagnetic shields. This index can create similar scientific literature to report the efficacy of electromagnetic shields and the selection of preferred shields in different research studies. It is suggested that future studies examine this quantitative index in other frequency ranges.

Keywords: Classification, Decision Making, Electromagnetic Radiation, Index, Microwave

1. Background

Radiofrequency and microwaves are parts of electromagnetic waves with a frequency of 3 kHz to 300 MHz with a variety of applications in military, medicine, telecommunication, etc. (1, 2). Therefore, many workers experience exposure to these radiations in various workplaces. Engineering control is the best safety approach to radio and microwave radiation protection to significantly reduce occupational exposure to radiation. So far, various studies have been carried out on electromagnetic shielding recommending occupational exposure control to protect workers against radiofrequency (3-7) and microwave (8, 9) radiation.

In recent years, there have also been many electromagnetic compatibility studies on nanocomposites for electromagnetic shielding (10-17). In electromagnetic shield topics, the selection of suitable shields is an important and interesting subject for experts in this field. The "check/control" is one of the steps to the implementation of occupational health and safety management systems in work environments. In this step, it is very important to use a precise and valid method to choose the optimal corrective action, especially when a variety of control measures exists. The lack of such a selection method/tool causes numerous problems such as wasting time and money and ineffectiveness of the applied control measures; the lack of a specific ranking index for choosing protective shields may also cause problems in making decisions in radiation